

AMENDMENT TO THE CLAIMS

1. (Currently Amended) A producing method of for producing carbon nanofibers, wherein comprising:

causing carbon nanofibers are caused to grow on surfaces of closely packed fine particles, a void ratio of the closely packed fine particles being 10% or less;

recovering the closely packed fine particles and fine particles with grown carbon nanofibers are recovered; and

separating the carbon nanofibers are separated from the surfaces of the closely packed fine particles by a physical process or a chemical process and to recover the carbon nanofibers are recovered.

2. (Currently Amended) The producing method of carbon nanofibers according to claim 1, wherein the growth reaction for causing the carbon nanofibers to grow is performed by either one of a gas flow layer reaction process, a fixed layer reaction process and a moving layer reaction process and a fluidizing layer reaction process.

3. (Currently Amended) The producing method of carbon nanofibers according to claim [[2]]1, wherein, when the growth reaction for carbon nanofibers is the causing the carbon nanofibers to grow is performed by a fluidizing layer reaction process[[,]] in which carbon nanofibers are caused to grow on the surfaces of fine particles utilizing the closely packed fine particles are utilized as fluidizing material, and simultaneously with growth of the carbon nanofibers, carbon nanofibers are separated by collision among fine particles simultaneously with growth of the carbon nanofibers, and to recover carbon nanofibers are recovered.

4. (Currently Amended) The producing method of carbon nanofibers according to claim [[2]]1, wherein, when the growth reaction for carbon nanofibers is causing the carbon nanofibers to grow is performed by the a fluidizing layer reaction process[[,]] in which the closely packed for causing carbon nanofibers to grow on the surfaces of fine particles utilizing fine particles are

utilized as fluidizing material[[,]] in a calm-slow fluidizing state is set and, and wherein the closely packed fine particles are violelty-vigorously stirred after reaction termination to separate carbon nanofibers by collision among the fine particles, and to recover carbon nanofibers are recovered.

5 – 7. (Canceled)

8. (Currently Amended) The producing method of ~~carbon nanofibers~~ according to claim 1, wherein the closely packed fine particles include ~~at least one kind of or a mixture of two or more kinds of selected from the group consisting of~~ silica sand, aluminosilicate, zeolite aluminum oxide, zirconium oxide, silicon carbide, silicon nitride, limestone, ~~and dolomite and the like, or one kind of the compounds thereof as a main component and the main component is included in an amount of 50 weight % or more.~~

9. (Currently Amended) The producing method of ~~carbon nanofibers~~ according to claim 1, wherein the closely packed fine particles from which the carbon nanofibers have been separated are recycled for reaction.

10. (Currently Amended) The producing method of ~~carbon nanofibers~~ according to claim 1, wherein a catalyst component is adhered to the closely packed fine particles.

11. (Currently Amended) The producing method of ~~carbon nanofibers~~ according to claim 10, wherein the catalyst component is ~~metal of one kind of or a combination of two or more kinds of includes at least one selected from the group consisting of~~ Na, K, Mg, Ca, Sr, Ba, Cr, Mn, Fe, Co, Ni, Mo, W, Ru, Rh, Pd, Ir, Pt, or lanthanoid element such as La, Ce or Pr, oxide thereof, chloride thereof, or and nitrate thereof.

12. (Currently Amended) The producing method of ~~carbon nanofibers~~ according to claim 11,

wherein the catalyst component contains [[S]]sulfur-component.

13. (Currently Amended) The ~~producing~~-method of ~~carbon nanofibers~~ according to claim 10, wherein additive particles for peeling off carbon nanofibers, which is different from the catalyst component in particle shape, size and material quality, [[is]] are used to separate the carbon nanofibers.

14. (Canceled)

15. (Currently Amended) The ~~producing~~-method of ~~carbon nanofibers~~ according to claim 1, wherein the separating includes

washing ~~carbon nanofibers peeled off from the closely packed fine particles are washed~~ with acidic solution,

adding an organic compound solution to the acidic solution containing the closely packed fine particles to disperse the carbon nanofibers in the organic compound solution, the organic compound solution being a mixture of additives ~~an additive having a functional group with high affinity with carbon nanofibers or having a functional group with lipophilic property, and an organic compound which is liquid in the normal~~ ~~at room temperature are mixed and added in acidic solution including the produced carbon nanofibers dissolved to disperse the carbon nanofibers in the organic compound solution, and~~

evaporating ~~the organic compound solution with the carbon nanofibers dispersed is evaporated to obtain the carbon nanofibers.~~

16. (Currently Amended) The ~~producing~~-method of ~~carbon nanofibers~~ according to claim 15, wherein the additive is a compound having a polynuclear aromatic functional group.

17. (Currently Amended) The ~~producing~~-method of ~~carbon nanofibers~~ according to claim 16, wherein the compound having a polynuclear aromatic functional group is either one of includes

at least one selected from the group consisting of anthracene, pyrene and chrysene, or a mixture thereof.

18. (Currently Amended) The ~~producing~~ method of carbon nanofibers according to claim 15, wherein the organic compound that is liquefied in the normal liquid at room temperature includes either one of at least one selected form the group consisting of normal hexane, toluene, tetrahydrofuran, dimethylformamide, and chloromethane, and the like, or a combination of at least two thereof.

19. (Currently Amended) A ~~producing~~ An apparatus of for producing carbon nanofibers comprising:

a reaction apparatus that supplies carbon raw material and closely packed fine particles to cause carbon nanofibers to grow on surfaces of the closely packed fine particles, a void ratio of the closely packed fine particles being 10% or less;

a heating apparatus that heats the reaction apparatus;

a recovery line that recovers the closely packed fine particles on which the carbon nanofibers have grown from the reaction apparatus; and

a carbon nanofiber separating apparatus that separates carbon nanofibers from the recovered closely packed fine particles on which carbon nanofibers have been grown.

20. (Currently Amended) The ~~producing~~ apparatus of for producing carbon nanofibers according to claim 19, wherein the reaction apparatus is one of a gas flow layer reaction apparatus, a fixed layer reaction apparatus, a moving layer reaction apparatus and a fluidizing layer reaction apparatus.

21. (Currently Amended) The ~~producing~~ apparatus of for producing carbon nanofibers according to claim 19, wherein a catalyst supplying apparatus that supplies catalyst to the reaction apparatus is provided.

22. (Currently Amended) The ~~producing~~for producing apparatus according to claim 21, wherein the catalyst supplying apparatus is a ~~liquefied state~~liquid supplying apparatus that supplies catalyst dissolved in carbon raw material into the reaction apparatus in a liquefied state.

23. (Currently Amended) The ~~producing~~for producing apparatus according to claim [[21]]~~22~~, wherein the catalyst supplying apparatus ~~that~~ supplies catalyst into the reaction apparatus in a solid state or a gaseous state.

24. (Currently Amended) The ~~producing~~for producing apparatus according to claim 21, wherein the catalyst supplying apparatus ~~that~~ supplies closely packed fine particles carrying catalyst on surfaces thereof into the reaction apparatus.

25. (Currently Amended) The ~~producing~~for producing apparatus according to claim 24, wherein the catalyst carrying apparatus carrying catalyst on surfaces of the closely packed fine particles is provided with a fine particle supplying apparatus that supplies closely packed fine particles into a carrying vessel main body, and a spraying unit that sprays catalyst to the closely packed fine particles supplied to the carrying vessel main body.

26. (Currently Amended) The ~~producing~~for producing apparatus according to claim 25, wherein the carrying vessel main body is of a fluidizing layer type and has a gas supplying apparatus that supplies fluidizing gas.

27. (Currently Amended) The ~~producing~~for producing apparatus according to claim 25, wherein the carrying vessel main body is ~~of a kiln type~~ and has a rotary drum.

28. (Currently Amended) The ~~producing~~apparatus of for producing carbon nanofibers according to claim 19, wherein an average particle diameter of the fine particles is in a range of 0.2 to 20~~[[nm]]~~mm.

29 – 31. (Canceled)

32. (Currently Amended) The ~~producing~~apparatus of for producing carbon nanofibers according to claim 19, wherein the closely packed fine particles include at least one kind of or a mixture of two or more kinds of selected from the group consisting of silica sand, aluminosilicate, zeolite aluminum oxide, zirconium oxide, silicon carbide, silicon nitride, limestone, ~~and dolomite and the like, or one kind of the compounds thereof as a main component and the main component is included in an amount of 50 weight % or more.~~

33. (Currently Amended) The ~~producing~~apparatus of for producing carbon nanofibers according to claim 19, wherein a reaction temperature at a time of contact between the catalyst and the carbon raw material is in a range of 300°C to 1300°C, and a pressure is 0.01MPa or more.

34. (Currently Amended) The ~~producing~~apparatus of for producing carbon nanofibers according to claim 19, wherein a collision unit that collides against closely packed fine particles is provided in the reaction apparatus.

35. (Currently Amended) The ~~producing~~apparatus of for producing carbon nanofibers according to claim 34, wherein the collision unit also serves as a heat transfer tube for temperature adjustment inside the reaction layer.

36. (New) A method for producing carbon nanofibers, comprising:

causing carbon nanofibers to grow on surfaces of closely packed fine particles, a void ratio of the closely packed fine particles being 10% or less, the closely packed fine particles including at least one selected from the group consisting of silica sand, aluminosilicate, zeolite aluminum oxide, zirconium oxide, silicon carbide, silicon nitride, limestone, and dolomite;

recovering the closely packed fine particles; and

separating the carbon nanofibers from the surfaces of the closely packed fine particles by a chemical process the carbon nanofibers.

37. (New) The method according to claim 36, wherein the causing the carbon nanofibers to grow is performed by a fluidizing layer reaction process in which the closely packed fine particles are utilized as fluidizing material in a calm fluidizing state, and wherein

the closely packed fine particles are vigorously stirred after reaction termination to separate carbon nanofibers by collision among the fine particles to recover carbon nanofibers.

38. (New) The method according to claim 36, wherein the closely packed fine particles include at least one selected from the group consisting of silica sand, aluminosilicate, zeolite aluminum oxide, zirconium oxide, silicon carbide, silicon nitride, limestone, and dolomite.

39. (New) The method according to claim 36, wherein the closely packed fine particles from which the carbon nanofibers have been separated are recycled for reaction.

40. (New) The method according to claim 36, wherein catalyst component is adhered to the closely packed fine particles.

41. (New) The method according to claim 40, wherein catalyst component includes at least one selected from the group consisting of Na, K, Mg, Ca, Sr, Ba, Cr, Mn, Fe, Co, Ni, Mo, W, Ru, Rh, Pd, Ir, Pt, lanthanoid element, oxide thereof, chloride thereof, and nitrate thereof.

42. (New) The method according to claim 41, wherein the catalyst component contains sulfur.

43. (New) The method according to claim 40, wherein additive particles for peeling off carbon nanofibers, which are different from the catalyst component in particles shape size and material quality, are used to separate the carbon nanofibers.

44. (New) The method according to claim 36, wherein the separating includes
washing the closely packed fine particles with acidic solution,
adding an organic compound solution to the acidic solution containing the closely packed fine particles to disperse the carbon nanofibers in the organic compound solution, the organic compound solution being a mixture of an additive having a functional group with high affinity with carbon nanofibers or having a functional group with lipophilic property, and an organic compound which is liquid at room temperature, and
evaporating the organic compound solution to obtain the carbon nanofibers.

45. (New) The method according to claim 44, wherin the additive is a compound having a polynuclear aromatic functional group.

46. (New) The method according to claim 45, wherein the compound having a polynuclear aromatic functional group includes at least one selected from the group consisting of anthracene, pyrene and chrysene.

47. (New) The method according to claim 44, wherein the organic compound that is liquid at room temperature includes at least one selected from the group consisting of normal hexane, toluene, tetrahydrofuran, dimethylformamide, and chloromethane.